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Experiment Station Work,

XVI.

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OLIVES.
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SELLING EGGS BY WEIGHT.
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UNFERMENTED GRAPE JUICE.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.
A. C. TRUE, Director.

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CONTENTS OF THE SERIES OF FARMERS' BULLETINS ON EXPERIMENT STATION WORK.

EXPERIMENT STATION WORK.

Editor: W. H. BEAL.

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ILLUSTRATIONS.

EXPERIMENT STATION WORK—XVI.[1]

LIMING GRASS LANDS.

The Rhode Island Station has for a number of years been conducting experiments to test the effect of lime alone or combined with other fertilizers on various crops under different soil conditions. Some of the general results of this interesting and valuable work have been referred to in a previous bulletin of this series.[2] A recent bulletin reports the results of experiments with lime as a fertilizer for grasses on an acid soil during 1897 and 1898. In these experiments the lime was used alone or in connection with other fertilizers—nitrate of soda, sulphate of ammonia, and dried blood to supply nitrogen; dissolved boneblack to supply phosphoric acid, and muriate of potash to supply potash. The lime had been applied at the rate of 2½ tons per acre in 1893, several years before this experiment was begun. The following grasses were seeded (at the rate of 15 pounds each per acre): Meadow oat grass, awnless brome grass, Kentucky blue grass, and orchard grass. The Kentucky blue-grass seed were apparently worthless and failed to germinate. A record was kept not only of the total yield on the differently fertilized plats, but also of the character of the hay, i. e., the proportion of true grasses and of weeds. The table below and the diagram (fig. 1) show the relative percentages of grass and weeds during two years on a portion of the plats.

Effect of lime on the growth of grass and weeds.

	No nitrogen.		Nitrate of soda.		Sulphate of ammonia.		Dried blood.		Unmanured.	
	Limed.	Unlimed.	Limed.	Unlimed.	Limed.	Unlimed.	Limed.	Unlimed.	Limed.	Unlimed.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Grass	90.8	81	91.5	96.3	89.5	31.1	83.1	35.3	91.6	27.3
Weeds	9.2	19	8.5	3.7	10.5	68.9	16.9	64.7	8.4	73.7

[1] This is the sixteenth number of a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

[2] U. S. Dept. Agr., Farmers' Bul. 65 (Experiment Station Work—II), p. 21.

In all cases liming increased the total yield to a marked extent, in many instances to over three times that of the unlimed plats. The liming also resulted in a decided decrease in the proportion of weeds (mainly sheep sorrel) in the hay. It is claimed that sorrel thrives best on an acid soil. The application of lime, by neutralizing this acid, renders the conditions unfavorable to the growth of this weed and improves the soil for the growth of the more valuable grasses. It was

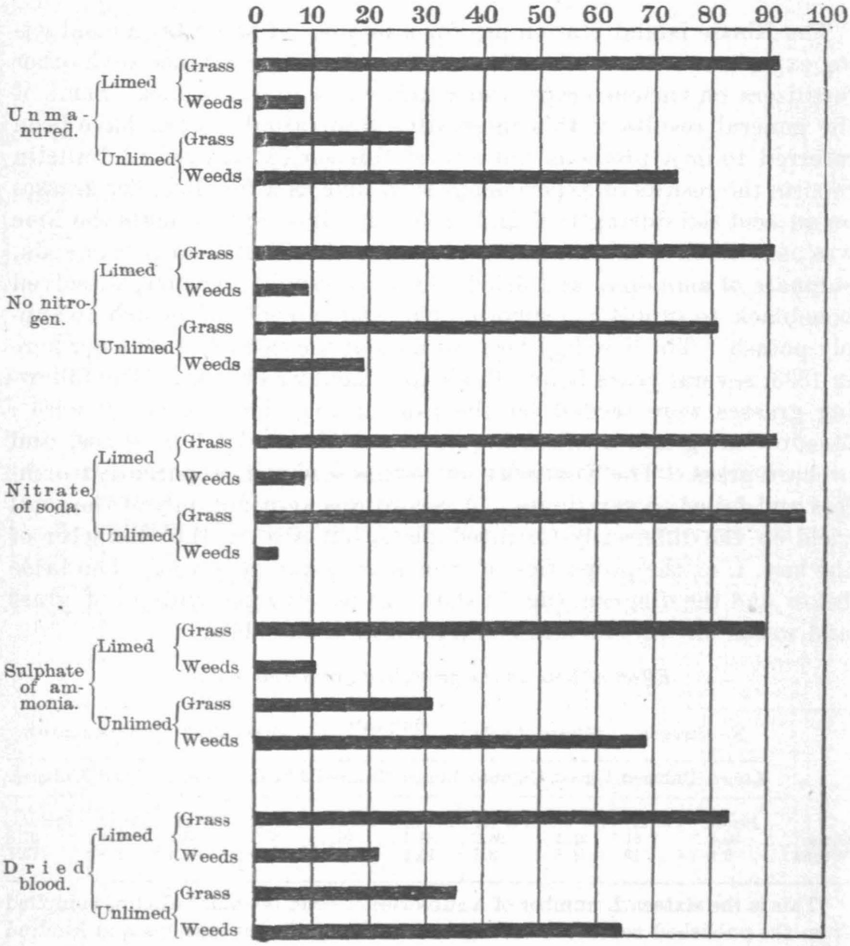

FIG. 1.—Diagram showing growth of grass and weeds on differently fertilized plats.

also noted that the yield of grass was greater and the proportion of weeds (sorrel) smaller on the plats fertilized with nitrate of soda, in addition to the lime, than on those fertilized with sulphate of ammonia or dried blood. This may be accounted for "chiefly by the fact that the residual soda of the nitrate of soda had doubtless gradually reduced the acidity of the soil to such an extent as to make it more favorable to grass, and, consequently, less favorable to common sorrel than where full rations of dried blood or of sulphate of ammonia had

been applied." The decomposition of the latter substances in the soil tend to increase its acidity and thus favor the growth of sorrel.

Of the three grasses which grew on the plats, orchard grass and awnless brome grass were most benefited by liming, and meadow oat grass least. The latter was benefited somewhat by lime in all except two cases, but it appears to be much less dependent upon its presence than are the other two grasses.

Timothy was not sown on the plats, but appeared in nearly every instance on the limed sections and but twice on the unlimed sections, indicating the value of neutral or slightly alkaline soils for this plant. Redtop appeared in but four instances, three of which were upon unlimed soil. This is in accord with previous observations at the station to the effect that redtop can succeed in a soil too acid for the successful growth of either blue grass or timothy. Clover was found upon every one of the limed plats, but was wholly absent from the unlimed sections, and the best clover was found upon the plats which had received potash and phosphoric acid, but no nitrogen.—THE EDITOR and C. B. SMITH.

EARLY PLOWING FOR WHEAT.

The opinion generally prevails that early preparation of land for wheat is an advantage. A number of stations have studied this problem and have reported results showing the advantages of breaking the ground for wheat upon the removal of a preceding crop of oats.

As the result of seven years' trial at the North Dakota Station, fall preparation for spring wheat gave an average increase in yield of 1 bushel per acre over spring preparation.

At the Kansas Station the average was even greater with early plowing for winter wheat. Starting the plow immediately after harvesting the previous crop resulted in a considerably increased yield over September plowing. Of two large plats lying side by side, one was plowed August 1 and the other September 7. The ground was very hard on both plats and broke up in large lumps. At the first plowing the land was comparatively free of weeds, while in the later breaking there was an even crop of weeds almost 1 foot in height. The early-plowed plat was disked twice to keep the weeds in check. The late-plowed plat was disked five times immediately after plowing to prepare it for planting. Both plats were seeded September 12 at the rate of 1¼ bushels per acre. At the time of seeding, the early-plowed plat was moist 3 inches below the surface, while the late-plowed plat was very dry. Though the latter was moist when turned up, it dried out rapidly when exposed to the sun. A large portion of the seed on the early-plowed strip germinated promptly, but on the late-plowed remained dormant until the October rains. The difference in the two plats was noticeable throughout the growing period. The early-

plowed plat ripened first and yielded at the rate of 14.57 bushels of grain and 0.7 ton of straw; the late-plowed at the rate of 11.99 bushels of grain and 0.49 ton of straw per acre.

In another trial at the same station two plats were plowed July 20, just after removing a crop of oats, and two others were plowed September 3. Several heavy rains occurred between these two dates, causing a packing of the first-plowed plats. They were also rather weedy at the time of seeding, and were disked to bring them into good tilth. All were seeded September 18. The wheat on the early-plowed plat came up first and was more uniform than on the late-plowed, and maintained the advantage throughout the fall. The early-plowed plats yielded at the rate of 23.66 bushels, the late-plowed at the rate of 19.74 bushels, per acre.

At the Michigan Station, in experiments recently reported, one plat was plowed for winter wheat immediately after removing the oat crop. The soil was rolled and harrowed at once, harrowing being repeated every 7 to 10 days until the wheat was sown. On another plat the ground after the removal of the oats was allowed to remain undisturbed until the day before sowing the wheat, when it was plowed, rolled, and harrowed three times. The early plowing, followed by rolling and repeated harrowing, approached the condition of summer fallow. In case of the late plowing, done September 16, the ground became very hard and lumpy and the plowing was difficult. It was impossible to prepare the seed bed as well as in the preceding case. The yield of the early-plowed plat was at the rate of 23.65 bushels; the late-plowed, 19 bushels of grain per acre.

Very similar experiments, with like results, are reported from the Oklahoma Station. Wheat seeded on oat land, plowed July 19, August 15, and September 11, yielded at rates of 31.3, 23.5, and 15.3 bushels per acre, respectively. Early plowing tended greatly to the suppression of weeds and the conservation of soil moisture in these experiments. Three days before seeding the early-plowed soil contained 16.8 per cent of moisture, the medium-plowed 13.9, and the late-plowed 7.7 per cent—some 4 per cent less than the amount required to germinate wheat readily.

At the Minnesota Station it was found that early plowing opened the surface of the ground so that the rainfall could be more readily absorbed, while the furrow slice formed an effective dirt mulch retarding the movement of moisture to the surface. This is a matter of much importance in a droughty region. It was also found that on unplowed land the growth of weeds following a crop of grain dissipated a large amount of the moisture that early plowing conserved.

The results secured in all these experiments are quite uniform in showing the good effects of early plowing for fall wheat. Briefly stated, early plowing, followed at intervals by harrowing, prevents the growth of weeds, conserves the moisture of the soil, keeps the soil in

good tilth, and results in the formation of a seed bed best suited for the prompt germination and growth of the seed. The cost of preparing the ground is lessened, the yield of grain is increased, and the practice is financially profitable.—D. W. MAY.

GRAFTING GRAPE CUTTINGS.

Results of experiments in bench-grafting resistant vines have recently been reported from the California Experiment Station. The experiments included tests of the relative value of English and Champin grafts (fig. 2), leaving two eyes on the scions and leaving only one, preliminary callusing in sand, planting out in the nursery immediately after grafting, and callusing in straw covered with sand. The cuttings used varied from one-fourth to one-half inch in diameter and were from 6 to 9 inches long. The lower cut was made through the knot of the bud and the last internode of the upper end left as long as possible. All the buds on the stock were carefully removed, a deep cut being made in order to remove the adventitious buds at the base of the main bud. When these buds are left to themselves, they frequently grow out and form suckers at the expense of the graft. "The cuttings thus prepared were sorted into three sizes, according to their thickness, put into bundles, and placed vertically in a tub of water so that the lower end was covered with water; the cuttings thus remained fresh and sappy, which greatly facilitated the making of cuts. The cuttings remained in water until they were needed for grafting"—from six to eighteen hours.

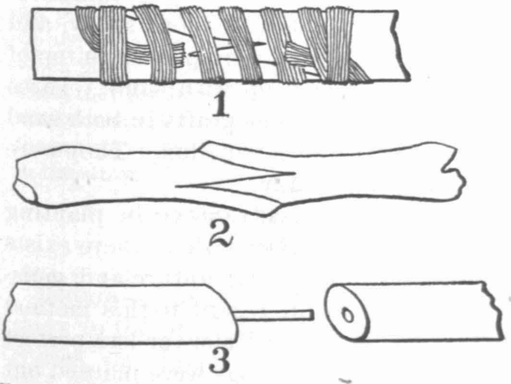

FIG. 2.—Grafts for grape cuttings: (1) English cleft; (2) Champin; (3) End-to-end.

Scions were prepared in a similar way, except that the buds were left. The scions having only one eye were cut through the second knot in order to leave the eye protected by a closed internode. With the scions having two eyes the upper cut was made about an inch above the second bud eye. Care was taken to prevent the drying out of the cuttings and afterwards of the grafts. Two methods of grafting were generally practiced—Champin and English cleft or whip grafting. Raffia was used as tying material. "End-to-end" grafting, as originated in France, was practiced in some instances. The number of successful grafts obtained by this method was low, but those that did

unite made excellent unions. In grafting by this method the ends of stock and scion are cut at an angle of about 70° and held in place by a piece of galvanized wire which is pushed into the pith of each piece (see fig. 2). The method is believed to be especially promising for machine grafting. All the grafts were tied in bundles of ten before being subjected to the different methods of callusing.

When the grafts were callused in sand the site selected for the location of the sand pile was on the south side of a building where the maximum amount of sunshine was available. A layer of about 4 inches of sand was used for the bottom. The grafts were put in vertically and covered about 2 inches deep with sand and the whole covered with a water proof cloth, the better to protect the grafts from excessive moisture and to maintain an even temperature of the sand during the night and in cold weather.

When straw was used as a material in which to callus the grafts a large box was used. The box was turned on its side and a layer 2 inches deep of moistened chopped straw first put in, followed by single alternate layers of grafts and straw until the box was full, after which it was turned up again, packed tight with more straw, and placed in the sand pile. Two inches of straw were placed on top of the grafts and the whole covered an inch deep with sand. Three hundred and sixty grafts were thus treated. The grafts in both sand and straw were left for from six to eight weeks to callus. They were planted out in the nursery about the 1st of May.

While it was known that there was a disadvantage in planting freshly grafted vine cuttings in the open nursery where there exists no practical means of sufficiently controlling temperature and moisture, yet, in order to secure "definite data in regard to this method in comparison with the preliminary callusing with more or less perfect control of temperature and moisture," 360 cuttings were planted out in the nursery directly after they were grafted. The sand and straw callused grafts were cultivated in the same manner as the noncallused grafts throughout the summer. The grafts were removed from the nursery in December. The following table summarizes the results obtained by the different methods of grafting and callusing:

Results of different methods of grafting vines.

Nature of experiment.	First-class unions.	Second-class unions.
	Per cent.	*Per cent.*
Champin grafts	44	11
English-cleft grafts	37	6
Scions with 2 eyes	46	13
Scions with 1 eye	38	7
Grafts callused in sand	61	7
Grafts callused in straw	46	12
Grafts not callused	26	13

The figures in the above table must not be taken as representing the exact relative values of the various methods compared, but * * * as valuable indications. * * * The proportion of successful Champin grafts, as shown by the

table, is slightly greater than that of the English cleft. The successful English-cleft grafts, however, were considerably superior to the other in the matter of completeness and strength of the union. The lower percentage is probably due to the fact that the English-cleft grafts were placed in the northerly end of the callusing sand heaps, where the temperature was too low.

The experiments with two-eye and one-eye scions on the whole were in favor of the use of two eyes. The additional chance of success given by two eyes when the first eye is injured by frost or other cause no doubt accounts for the higher percentage of success in this case. In the case of the grafts planted out immediately after grafting, the one-eye scions made on the whole the strongest growth. This seems, however, to be due to the fact that the upper eye of the two-eye scions started and broke through the sand early enough to be killed by the spring frosts, while the one-eye scions, being more deeply buried, were later in emerging and escaped the frost. This gave the latter an earlier start and therefore a longer period of growth, for there was a check of growth and an interval of waste time in the former case between the killing of the upper bud and the starting of the lower. The remedy here, therefore, if this explanation be true, is a deeper layer of sand over the scions, and not the use of only one eye.

The difference between previously callusing the grafts in sand and planting them directly in the nursery as soon as made is very striking. Those previously callused produced 61 per cent of good unions, while the others produced but 26 per cent. There was also a difference in the growth of the grafts in favor of those callused in sand. The grafts callused in straw were a disappointment, for, though when planted out they seemed to have callused more successfully than those in sand, they produced only 46 per cent of sufficiently good unions, and these were weaker than those of the grafts callused in sand. The cause of this was probably the growth of molds and wood-rot fungi around and in the unions while they were in the straw.

—C. B. SMITH.

CULTURE AND USES OF OLIVES.

Culture.—A recent report from the California Station calls attention anew to the olive industry. This subject, as it concerns the United States, was reviewed in considerable detail in the Yearbook of this Department for 1896. Several reports on olives have also been issued by the California State board of horticulture. The olive seems especially adapted to certain parts of California. For this reason the only station which has done any considerable amount of work with the olive is that of California. This discussion of the commercial and cultural condition of olives in California and of the food value of olive products is therefore based mainly on reports from the California station.

The olive tree is a slow-growing evergreen, of great longevity and productiveness. In some of the older countries about the Mediterranean trees hundreds of years old and sometimes 20 feet or more in circumference have been reported. When grown naturally the tree attains a height of 40 feet or more and has a somewhat rounded form. The leaves are small and lance shaped, dull green above and silvery beneath, and generally opposite. The flowers are small and white, with a four-cleft calyx and corolla. The fruit is a drupe, usually oval or nearly globular. (See fig. 3, *b*.)

The olive is a comparatively recent fruit in the United States, for, while it has been grown in California since the time of the early mission fathers, it is only within the past twenty years that it has become of commercial importance. The recent investigations of the station show that the industry as a whole is still in a somewhat unsatisfactory condition, owing largely to confusion in regard to the selection of suitable soils and varieties and a knowledge of right methods of culture and manufacture. Competition with cottonseed oil and other oils sold as olive oil also tends to harm the industry. On the whole, however, there seems to be a good and growing demand all over the United States for olive products. The California Station believes that the profits in the olive industry lie principally in the production of pickles, the larger fruit being used for this purpose and the small sized made into oil.

FIG. 3.—The olive: *a*, flower; *b*, *c*, fruit.

Olives will not thrive in regions where the temperature frequently falls below 20° F. They succeed best where the mean temperature of the coldest month does not fall below 43° F. The tree has a deep, strong root system which enables it to do well on rather dry soils; but where the rainfall is very light irrigation must be practiced. Contrary to the usual belief that olives will produce crops where other fruit trees will not live, the soil requirements of the olive are as great as those of any other crop. It seems especially suited to sandy or loam soils rich in lime and potash.

Analyses made by the California Station show that about 20 per cent of the ash of the branches, 20 per cent of the ash of the leaves, and 60 per cent of the ash of the fruit of the olive is potash, while lime constitutes about 54 per cent of the ash of the branches, 46 per cent of the ash of the leaves, and 16 per cent of the ash of the fruit. The percentage of phosphoric acid in the ash of the different parts varies from 12 per cent in the branches to 10.5 per cent in the leaves and 8.3 per cent in the fruit. Nearly all the soils of California have been found by analysis to be abundantly supplied with lime and potash. Phosphoric acid is more sparingly represented, and nitrogen is found in small quantities only, except in some localities where there is nitrate. Phosphoric acid and nitrogen, then, are the elements that most frequently need to be applied to California soils in the production of olives. The manuring must not be heavy if oil of superior quality is to be obtained. Heavy manuring, while giving large crops, produces an oil of inferior quality and difficult to keep.

Olives may be propagated by all the usual methods for growing orchard trees. They are usually propagated from cuttings, though the best rooted and hardiest trees are grown from seed. When propagated from cuttings, young shoots several inches long, with well-hardened wood, are cut from vigorous trees. All the leaves are then removed except two or three at the top, after which the cuttings are planted in shallow boxes of moist sand and kept in a greenhouse or warm, shady place. At the end of three or four months most of the cuttings will be well rooted and should be transplanted to pots or to the nursery, where they will receive more sunshine. Three or four months later they may be planted in place in the orchard. By this method well-rooted and vigorous trees are produced, which sometimes yield fruit within four or five years from the time the cuttings are planted in the sand.

When the trees are propagated from seed the pits should be removed from the olives and the shell softened by soaking for about twenty-four hours before planting in a lye solution containing one-half pound of caustic soda to 1 gallon of water. If the shells are not thus softened they should be cracked before planting, as otherwise the seed will remain in the ground two years before germinating. Trees grown from seed revert more or less to the original wild type. It is thus necessary to graft or bud them with the variety which it is desired to propagate. Usually the seedlings are not large enough for this purpose until the second spring after planting. The grafts are taken from 2-year-old wood and put in at the neck of the roots just below the surface of the ground. Ordinary wedge grafts are usually used, the wound being covered with grafting wax and the whole banked up with earth until only two eyes of the graft are exposed. If the seedlings are large and have thick bark they may be budded on the stem just above the ground. The trees may be planted out in the permanent orchard

within a year after grafting or budding, after which they will require careful attention as regards cultivation, manuring, and watering, for the next few years. Other methods of propagation are by stooling; by burying sections of large olive limbs and cutting away and planting the rooted sprouts which they will send up; by planting, after danger of frost is past, the knot-like swellings which occur on the trunk and roots of many varieties; by gouging out and planting in the nursery the suckers from the parent tree, care being taken to secure enough wood of the parent stock to prevent too rapid drying out, etc.

In improving old trees the ordinary methods of grafting or budding may be employed. In the case of budding, the ordinary T and shield methods are employed most frequently. In this work it is essential that the bud be taken from good, healthy wood and inserted in vigorous shoots. "Most of the failures in budding result from using a shoot of low vitality as a stock." In order to secure strong shoots, the trees to be budded may be severely pruned, cutting back half the branches the first year if the tree is large and the remainder the next. Dormant twig buds cut deeply and part of the wood removed and inserted in the ordinary way are considered most satisfactory for scions. About two-thirds of each leaf on the twig bud should be cut off to prevent drying out by evaporation. "Budding may be done at any time when the sap is flowing freely, but is most successful if done in the early summer or spring."

An extensive study was made by the station of the condition of olive culture in the State. Some fifteen counties were visited, and all the reported failures as well as the successful orchards were investigated. Olive culture was found to be as successful and profitable an industry as the growing of any other fruit whenever trees of suitable varieties planted on suitable soils were given proper care and the crops properly harvested and manufactured. As a result of the investigation, systematic cultivation of orchards to retain soil moisture is urged. Irrigation should be given where the rainfall is light, and in localities where water in summer is scarce winter irrigation may be practiced with excellent results. The olive is sensitive to an excess of water, "but it must have as much as any other tree if good, well-developed, and mature fruit is desired."

The theory that the olive needs no pruning has been found to be erroneous. "There is perhaps no tree known that requires more constant and systematic pruning than the olive, * * * and wherever rational pruning was practiced regular crops were found to be the invariable results." The key to olive pruning is found in the fact that the tree bears fruit only on wood of the preceding year's growth and never twice in the same place; further, that the tendency of the tree when left to itself is to produce vertical wood branches. Now, if these wood branches are deflected from the vertical they become

enfeebled and thus more inclined to the production of fruit, and the greater the deflection the greater the fruit production "up to the point of becoming too feeble to make growth or furnish sufficient sap for the nourishment of the fruit." The problem of the pruner, therefore, is the proper regulation of the kind and amount of branches on the tree in order to secure a constant supply of fruit-bearing wood, and in this work the element of judgment plays an important part. With a feeble tree severe pruning for wood branches is desired, while a vigorous tree may be checked by converting the wood branches by deflection into fruit branches.

Trees may be pruned early in the season, but the most convenient time is believed to be immediately after the harvest, as at that time no fruit is lost. Young trees should receive two or more light annual prunings, and heavily fruited trees can be economically pruned by pinching back the too vigorous shoots. Low pruning is generally advised, since it facilitates the operations of both pruning and picking, but on low ground, where frosts are to be feared, high pruning should be practiced. The factors of air and light must be considered, as in the pruning of other orchard trees. A vase shape, inclining more to spherical when the branches are heavy with fruit, is advocated.

The olive bears perfect or self-fertile blossoms. Some early experiments reported by the station, however, seem to show considerable difference in different varieties as regards their ability to fertilize themselves and set fruit. "All of the smaller varieties, without exception, failed to fertilize their own flowers when confined in paper bags; some of the medium-sized varieties of olives fertilized their own flowers perfectly, others imperfectly, and some of them not at all. All of the large-sized olives experimented with fertilized their own flowers perfectly." The keeping of a dozen stands of bees in each 20 acres of orchard during the blossoming period has been found one of the most practical remedies for failure of trees to set fruit.

The black scale (*Lecanium oleæ*), with its accompanying fungus the black smut, as well as some other scales, have been found in olive orchards and most frequently along the coast in the foggy region. They have been successfully combated by washes, fumigation, and in some instances by an Australian ladybird. The olive knot seems to be the only dangerous disease of the trees yet observed in California, and this disease has largely been eradicated from the State by the prompt action of the county horticultural commissioners and olive growers in infected districts. A new disease, which appeared in California in 1897 and which has since spread all over the State, affects especially the fruit. It is described as a dry rot and affects a large number of varieties. No method of controlling it has as yet been found.

Some 70 different varieties of olives are now grown in California. In general, all the large-fleshed olives, like the Sevillano, Ascolano,

St. Agostino, Cucco, Polymorpha, Macrocarpa, and Obliza are so delicate that they are suitable only for green pickles. There is no specific variety known as the "queen" olive, but any very large olive may be thus designated. Large Mission is considered the best variety for ripe pickles for marketing. Rubra and Pleureur de Grasse are considered excellent oil varieties and make good ripe pickles for home consumption.

Uses of olives.—Two food products of considerable importance are made from olives, namely, olive oil or salad oil and pickled olives. A third product, little known in this country, is the dried olive, much eaten in Greece and some other neighboring countries. All olive oil and pickled olives were formerly imported, most generally from southern Europe. In recent years California has developed olive growing, and the industry has now assumed considerable importance. The California Station has done much to foster it. The methods of extracting oil and pickling the fruit are described in a recent bulletin of the station, which also reports a number of analyses of fresh and pickled olives.

The ripe olive fruit is not unlike an oval damson plum in form and size. In color it ranges from various shades of purple to almost black. It has a sour and persistent bitter flavor. Samples of many different varieties analyzed at the station varied greatly in size, ranging from less than 100 to over 400 to the pound, the majority, however, ranging from 150 to 250 to the pound. The pit constitutes about 20 per cent of the whole fruit, but here a considerable range is also found. Both pulp and pit contain oil. The amount of oil in the pulp in different samples analyzed ranged from 13 to about 88 per cent; that in the pit from 0.36 to 1.52 per cent. It is stated that these values were obtained from fruit grown in an unfavorable year.

Whether used for oil making or for pickling the olive should be carefully gathered. The ripe fruit is used for oil making and for pickling, the exact stage when it is best suited for this purpose being a matter which must be learned by experience. The green fruit is also used for pickling and should be gathered when full grown and just before it begins to color and soften. The pickled olives usually found in the American market are made from the green fruit. The pickled ripe olives are also met with and may be recognized by their dark color.

The best oil is made by crushing the carefully picked fresh olives. To facilitate the extraction of the oil the olives are often partially dried before crushing. Old-fashioned stone mills are commonly used to crush the fruit, although bronze crushers are being tried with good results. The ground mass is pressed to extract the liquid portion, which contains watery plant juices in addition to the oil and more or less pulpy matter. Various devices are used to separate the oil and to purify it. It is said that the best oil is obtained by allowing the

pulp, etc., to settle, and decanting the clear oil. It generally takes about one month for oil to settle the first time. Three rackings are usually sufficient. The oil thus obtained is almost as bright as can be produced by the most effective filtration, and it has, besides, the distinctive olive flavor and lacks the greasiness which is characteristic of all filtered oils. Great cleanliness must be observed in oil making and every precaution taken to avoid rancidity.

Essentially the same process is followed in making pickles from ripe and green olives. The unpleasant acid and bitter flavor is removed by soaking the fruit in a solution of potash lye for a short time or by a longer soaking in water. In addition to removing the unpleasant flavor, the lye softens the skin of the fruit, so that the undesirable substances may be more readily extracted by water. Olives treated with lye must be soaked in clear water, which is frequently changed, to remove the potash. They are then placed in weak brine for a short time and afterwards in stronger brines. The details of each step of the process vary considerably, and much depends upon skill and experience. An abundant supply of pure water is of the first importance, and great care must be exercised to prevent the growth of molds, etc. As in the manufacture of oil, cleanliness is a prime requisite.

The uses of olive oil and olives as articles of diet are familiar. The former is used chiefly for dressing salads and for frying, the latter as a relish, for seasoning sauces, etc., and for garnishing various foods. The oil, like all fats, has a high fuel value, and on this its value as a food depends. The California Station insists that the pickled ripe olives are more than a relish; that they really possess a considerable food value, much more than the pickled green fruit. This statement is borne out by their composition as determined by analysis.

Composition of pickled ripe and green olives.

	Water.	Fat (oil).	Carbohydrates.	Protein, ash, etc.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Pickled ripe olives	65.08	25.52	3.75	5.65
Pickled green olives	78.41	12.90	1.78	6.91

The green olives "are simply a relish and to be used in very limited quantities in the same way as pickled walnuts or cucumbers. A meal of bread and ripe olives is not only palatable, but nutritious and sustaining, and the amount eaten is to be limited only by the same considerations as that of any other good, wholesome food." In southern Europe and other regions the ripe olive is used as a staple article of diet, and there is apparently no reason why it should not prove a useful food in this country also, as it is conceded to be very palatable. The use of the green pickled olive will undoubtedly increase

also, for its flavor is quite generally liked and it aids in giving variety and attractiveness to the diet, features which are by no means unimportant.—C. B. SMITH and C. F. LANGWORTHY.

NUTS AS FOOD.

As indicated by the numerous nut foods on the market and the discussions in papers and magazines of systems of diet in which nuts play a prominent part, there is a quite general interest in the subject. The claims made for some nut foods often seem extravagant and unreasonable. Apparently they lack any basis of experimental evidence, nor is it probable that the best-informed physiologists would advise the wholesale use of nuts in a diet to the exclusion of more usual and generally accepted foods.

The composition and food value of a number of nuts have been studied by the California and Maine stations. Special studies on chestnuts have also been reported by the Pennsylvania and Massachusetts stations.

The following statements concerning the general characteristics of the nuts commonly eaten in this country are chiefly taken from the report of the studies at the Maine Station.[1]

The almond is a favorite dessert nut in this country. By far the larger part of the almonds consumed is supplied by France, Italy, and Spain. California, however, has grown the almond successfully, and the output of this crop is annually increasing. The almond is used in making confectionery, creams, cakes, etc.

The Brazil nut, as its name indicates, is a native of Brazil, whence it is exported in large quantities. It has not been successfully grown in the United States. It is chiefly used as a dessert nut.

The filberts found in our market are chiefly varieties and crosses of two species. The native hazels are smaller than the European nuts, but have an agreeable flavor. The filbert is chiefly used as a dessert nut, but the ground nut is sometimes used for confectionery and in other ways. In some European countries, where it grows abundantly, a sort of bread is made from the ground nut.

The hickory nut, under which general name is included the nuts of several species of native trees, of which the shagbark (*Hicoria ovata*) is the most important, is one of our best-known nuts. The quality of the hickory nut is exceedingly variable, both in flavor and the readiness with which the shell may be removed. The better varieties are highly esteemed, and by many are considered to compare favorably in delicacy of flavor with the English walnut. Large quantities of the nuts are eaten, and they are sometimes used in making cakes and

[1] More complete accounts of the various nuts grown in the United States were given in a bulletin on Nut Culture in the United States, issued in limited edition by the Division of Pomology of this Department in 1896.

confectionery. There is some confusion regarding the name of this nut. In some regions of New England it is known as the walnut, while the nut more generally known in the United States as the walnut, and which grows only sparingly in New England, is designated the black walnut.

The pecan (*Hicoria pecan*) is also a native of America, but is less widely distributed than the hickory, to which it is closely related. The flavor of the pecan makes it a desirable nut, but it doubtless owes much of its popularity to its thin shell and the ease with which the kernel may be removed. It is largely used as a dessert nut. Quantities are also used by the confectioners for making salted pecans, bonbons of various sorts, etc.

The English or more properly Persian walnut (*Juglans regia*) has been successfully cultivated in several regions of the United States. It is of Asiatic origin, but owing to its general excellence it early won its way to popular favor, reaching England about the middle of the sixteenth century. It is a favorite dessert nut, and is also used by confectioners in many ways.

What is most generally known as the walnut in the United States (the fruit of *Juglans nigra* and closely allied species) is a large nut rich in oil and having a strongly marked flavor. This nut is somewhat used by confectioners.

The butternut, oil nut, or white walnut (*Juglans cinerea*) is extremely oily and has a tendency to become rancid. The fresh nut has an excellent flavor. It is less commonly marketed than some other native nuts.

The beech nut is the fruit of a forest tree common in the eastern half of the United States. The nuts are sweet and of very agreeable flavor. Owing to their small size and the consequent difficulty of gathering them only a limited amount reaches the market.

The pistachio, although a native of Syria, has long been cultivated in southern Europe, whence most of the nuts eaten in this country are obtained. It has been grown to a limited extent in the United States. The kernel is greenish in color and has a mild, pleasant, and characteristic flavor, suggestive of almonds. It is chiefly used in the manufacture of confectionery, ices, etc., being valued for its flavor and the delicate green color which it imparts.

Although the cocoanut is a native of the Tropics, it has been successfully grown in Florida. Only the mature nuts commonly find their way into the market, though the fruit of the green nut is much relished where it is available. Large quantities of the dried and grated nut are consumed. Its uses for confectionery, cakes, etc., are numerous and well known.

The chestnut has been spoken of at length in a previous bulletin of this series.[1]

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[1] U. S. Dept. Agr., Farmers' Bul. 114 (Experiment Station Work—XIV), p. 9.

In many regions of the West and Southwest several varieties of pine nut are eaten.

One of the fruits most commonly eaten in the United States under the name of nut is the peanut. Strictly speaking, this is not a nut, but the fruit of a leguminous plant closely related to the pea or bean. Probably three-fourths of the peanuts eaten are roasted. Part of the cheaper grades are used by confectioners for making salted peanuts and various forms of peanut candy, etc. A sweet and palatable oil can be made from the peanut. The uses of the peanut as a food have been spoken of in other farmers' bulletins.[1]

Several varieties of acorns are sweet and rather palatable. They are, however, little eaten.

The litchi, or leechee, nut is a native of China. It is chiefly eaten in this country by the Chinese population, although it possesses an agreeable flavor and is becoming more generally known. It is not, strictly speaking, a nut, but a dried fruit.

The composition of the above nuts is shown in the following table, which also includes, for purposes of comparison, several staple articles of diet.

Composition of nuts and some other food materials.

	Refuse.	Edible portion.	Composition and fuel value of the edible portion.					
			Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value, per pound.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Almonds	64.8	35.2	4.8	21.0	54.9	17.3	2.0	*a* 3,030
Brazil nuts	49.6	50.4	5.3	17.0	66.8	7.0	3.9	3,329
Filberts	52.1	47.9	3.7	15.6	65.3	13.0	2.4	3,432
Hickory nuts	62.2	37.8	3.7	15.4	67.4	11.4	2.1	3,495
Pecans	53.2	46.8	3.0	11.0	71.2	13.3	1.5	3,633
English walnuts	58.0	42.0	2.8	16.7	64.4	14.8	1.3	*a* 3,305
Chestnuts, fresh	16.0	84.0	45.0	6.2	5.4	42.1	1.3	*a* 1,125
Chestnuts, dried	24.0	76.0	5.9	10.7	7.0	74.2	2.2	*a* 1,875
Acorns	35.6	64.4	4.1	8.1	37.4	48.0	2.4	2,718
Beechnuts	40.8	59.2	4.0	21.9	57.4	13.2	3.5	3,263
Butternuts	86.4	13.6	4.5	27.9	61.2	3.4	3.0	3,371
Walnuts	74.1	25.9	2.5	27.6	56.3	11.7	1.9	*a* 3,105
Cocoanut	48.8	51.2	14.1	5.7	50.6	27.9	1.7	2,986
Cocoanut, shredded	....	100.0	3.5	6.3	57.3	31.6	1.3	*a* 3,125
Pistachio, kernels	....	100.0	4.2	22.6	54.5	15.6	3.1	*a* 3,010
Pine nut or piñon (*Pinus edulis*)	40.6	59.4	3.4	14.6	61.9	17.3	2.8	3,364
Peanuts, raw	24.5	75.5	9.2	25.8	38.6	24.4	2.0	*a* 2,560
Peanuts, roasted	32.6	67.4	1.6	30.5	49.2	16.2	2.5	3,177
Litchi nuts	41.6	58.4	17.9	2.9	.2	77.5	1.5	1,453
Beefsteak	12.8	87.2	61.9	18.9	18.5	....	1.0	*a* 1,130
Wheat flour	....	100.0	12.8	10.8	1.1	74.8	.5	*a* 1,640
Potatoes	20.0	80.0	78.3	2.2	.1	18.4	1.0	*a* 385

a These values were calculated; unless otherwise indicated the fuel values were determined.

It is pointed out by the Maine Station that from 50 to 65 per cent of the nuts most commonly eaten (almonds, Brazil nuts, filberts, hickory nuts, pecans, and walnuts) is shell. All these nuts contain little water. The protein is fairly high, but fat constitutes the largest part of the edible portion. The carbohydrates, which usually occur in large proportion in vegetable foods, are present only in small amounts.

[1] U. S. Dept. Agr., Farmers' Buls. 25 and 121.

The chestnut is an exception, containing, as it does, nearly 40 per cent carbohydrates. The percentage in cocoanuts, acorns, and litchi nuts is also fairly high. The meat of nuts, excepting those last mentioned, contains nearly 50 times as much fat and less than one-fifth as much carbohydrates as wheat flour, and has about double the fuel value, i. e., energy-producing power. A pound of unshelled nuts will furnish about half as much protein and the same amount of energy as a pound of flour. Owing to their high fuel value and low protein content, nuts would not make a well-balanced food when eaten by themselves.

This unsuitableness for a food by themselves is also increased by the potential energy being stored in the concentrated form of fat. This is no reason, however, why nuts should not fill an increasingly large place in dietaries. Very few foods supply the needed nutrients in the proper proportion to form a well-balanced ration. Foods rich in fuel constituents need to be combined with other foods of relatively high protein content. The low percentage of carbohydrates in nuts would seem to fit them as one of the sources of food for diabetic and other persons who find it needful to avoid foods containing much starch or sugar.

The chestnut differs materially from the six nuts [mentioned above as most commonly eaten]. It contains [about the same amount of protein], only one-fourth as much fat, and six or seven times as much carbohydrates. Indeed, its high starch content explains why chestnuts are so little eaten raw. * * *

Peanuts have a fuel value of only 96 calories for each 0.01 pound of protein, and hence have a relative excess of protein. This is so unlike other vegetable foods, with the exception of the near relatives of the peanut, as peas and beans, that it is of great importance. * * *

In this country nuts will [probably] never to any great extent replace the cereal foods, as is the case in some sections of the Old World. Not only would the original cost prevent, but the labor involved in shelling and preparing nuts for the table would prove a serious obstacle to their extended use.

While nut meats are generally eaten without any previous preparation, they may be used in a variety of ways. Chopped nut meats are much relished for sandwiches, and nut salads are not uncommon, while certain nuts are often used as stuffing for roast fowl. The use of nuts in cakes, confectionery, creams, etc., has already been alluded to. Many attempts have been made to prepare nut foods and to extend their use in various ways. Peanut butter, as it is called, is marketed to a considerable extent. This is said to consist of the kernels ground, with or without the addition of a small proportion of water.

The nuts, particularly the peanut and chestnut, afford interesting opportunities for the housewife skilled in adding to the list of "good things." Attention has been called to the fact that nuts form a very concentrated food. They should therefore be eaten with [more bulky] foods and, except in the case of the peanut, with those richer in protein.

There are no reliable data regarding the digestibility of nuts. The belief in their indigestibility seems to be widespread, and perhaps has some basis in fact. It is quite probable that if the nuts were properly prepared and eaten at proper times much of this prejudice would disappear. Our present practice of munching them at odd hours, or as a dessert, when sufficient food has been taken to meet the requirements of the body, overtaxes the digestive organs and places the nut under a reproach that is, at least in part, undeserved.

There is a widespread belief that salt aids in the digestibility of nuts, and experience seems to bear out this opinion.—C. F. LANGWORTHY.

COFFEE SUBSTITUTES.

Coffee substitutes of domestic manufacture have long been known. An infusion of parched corn, or corn coffee, has met with some favor in the household as a drink for invalids, etc. Parched wheat, peas, beans, and corncobs, as well as sweet potatoes, cut into small pieces and dried and parched, have also been used. Such drinks are usually resorted to in times of scarcity, or when, for one reason or another, it is not possible to obtain true coffee. Chicory is also a well-known substitute for coffee, although it is generally used mixed in larger or smaller proportion with true coffee, and by many such mixtures are preferred to coffee alone, as the chicory is thought to improve the flavor.

There has recently appeared on the market a considerable number of coffee substitutes which generally claim to be made from cereals. In most cases the claim is also made that such beverages are especially wholesome, and in some cases that they have a high food value. The value as food of coffee or any such beverage is evidently due (1) to the material extracted from the coffee (or other substance) by the water used, and (2) to the sugar and milk or cream added to the infusion. As the bulk of the infusion is water, it is obvious that the food value can not be great.

The composition of a large number of samples of coffee and coffee substitutes has been studied at the Connecticut State Station. The food value of coffee substitutes has been studied by the Maine Station.

The Connecticut State Station found that while some coffee substitutes contain a little true coffee, probably added to give them flavor, most were, as they claimed, free from coffee. Such goods were usually composed of one or more roasted grains (barley, wheat, etc.), pea hulls, and a paste made of wheat middlings. Flour, meal, and other ground grains contain a little soluble material, but, as is well known, the bulk of the material in them is insoluble. When the cereals are roasted, a portion of the carbohydrates is caramelized and rendered soluble. It is therefore undoubtedly true that the roasted material is more soluble than the unroasted. The infusion of the cereal coffees studied at the Maine Station was in every case made according to the directions accompanying the material. The amount of the cereal coffee which was recommended to be used varied considerably, and consequently the strength of the infusion varied within rather wide limits. When made according to directions, a pound of material yielded from 20 to 180 cups.

The average amount of soluble material in the different samples (and hence the total food material in the infusion, not counting sugar and milk or cream added) varied from 22.4 to 51.2 per cent. This was

made up of from 1.4 to 4.9 per cent protein, 13.4 to 44.9 per cent carbohydrates, and 1.5 to 4.1 ash. The average cereal coffee infusion had the following percentage composition: Water, 98.2; protein, 0.2, and carbohydrates, 1.4, while the fuel value was 30 calories per pound. Skim milk, which is ordinarily considered a rather "thin" beverage, contains 3.5 per cent protein, 0.3 per cent fat, 5.15 per cent carbohydrates, and 0.8 per cent ash, or almost twenty times as much food material as the average of the beverages made from cereal coffee. If made according to directions, one would have to drink 4½ gallons of an infusion of one of them which made an especial claim to high nutritive value in order to get as much food as is contained in a quart of skim milk.

The comments here made are in no wise intended to condemn these beverages, but to point out that the claims for great nutritive value are not founded on fact. Whether hot beverages are or are not hygienic, a chemical study can not show, but from the chemical composition of the infusions it is a simple task to pass upon their merits as food.

The infusion of true coffee also contains very little nutritive material. However, it is not ordinarily consumed on account of its food value, but on account of its agreeable flavor. It also contains a small amount of an alkaloid, caffeïn, which has stimulating properties. This is entirely lacking in cereal coffees if they are, as they claim, made entirely from cereal grains.—C. F. LANGWORTHY.

THE WORKING OF A PURE-FOOD LAW.

In 1898 the general assembly of Kentucky enacted a law providing for the inspection of food products sold in that State, and intrusted the work to the agricultural experiment station. The station has recently submitted a report of operations under the law in 1898 and 1899. The main results are summarized in the following table:

Kind and number of samples collected from June 13, 1898, to December 31, 1899.

Article sampled.	Not found adulterated.	Adulterated.	Total.
Baking powder	11	45	56
Butter	118	29	147
Canned goods	6		6
Catsups, pickles, etc	12	45	57
Coffee	2	1	3
Corn starch	1		1
Flour (wheat)	20		20
Jellies, preserves, etc	5	18	23
Lard	29	11	40
Milk (sweet and buttermilk)	115	35	150
Milk color	1		1
Mince-meat		7	7
Oleomargarine	2	16	18
Olive oil	1	1	2
Pepper, spices, etc	3	11	14
Sweet cider and grape juice		3	3
Soda (cooking soda)	3		3
Sirups, honey and sugar	41	9	50
Vinegar	67	59	126
Total	437	290	727

These results clearly show the necessity for a pure-food law. "Fully 40 per cent of all samples of food taken have been found adulterated. Some of the adulterants used are injurious to health; others have been put in to cheapen articles of food." As examples of the former, the inspectors found so-called "fruit jellies" made wholly or in part of glue and artificial coloring and flavoring matters.

They found salicylic acid, sometimes in large quantities, in tomato catsups, preserves, and other food products which were sold as pure, and formaldehyde and other preservatives in milk, which perhaps in some cases was fed to infants. The most striking example of all is in the case of essence of peppermint and essence of cinnamon. * * * These extracts both contained "wood alcohol," a poisonous substance, as one of the ingredients. * * * In the preparation of these essences a mixture of wood alcohol and common alcohol was used in place of common alcohol, presumably to avoid the Government tax on alcohol.

This condition of affairs is by no means confined to Kentucky. Equally flagrant instances of adulteration are reported in the publications of other stations engaged in the inspection of foods and from many other sources.—THE EDITOR.

SELLING EGGS BY WEIGHT.

The North Carolina Station, in connection with some of its recent poultry experiments, recorded the weight of eggs per dozen as well as the number of eggs produced by pullets and old hens of a number of well-known breeds and by Pekin ducks during six months.

Generally speaking, larger eggs were laid by hens than by pullets of the same breed. The eggs laid by the Pekin ducks (old and young) were heavier than those laid by any breed of hens, weighing 35.6 ounces per dozen. Of the different breeds of hens tested the largest eggs were laid by the Light Brahmas, weighing 28 ounces per dozen. The Black Langshan and Barred Plymouth Rock hens' eggs weighed a little over 26 ounces per dozen, while those laid by Single Comb Brown Leghorns, late hatched Plymouth Rock, White Wyandotte, and Buff Cochin hens ranged from 21.7 to 23.7 ounces per dozen.

Of the pullets, the heaviest eggs were laid by the Black Minorcas, weighing 26.5 ounces, the lightest by the Single Comb Brown Leghorn and Silver-Laced Wyandottes, weighing 17.5 and 22.1 ounces per dozen respectively. The Barred Plymouth Rock, White Plymouth Rock, White Wyandotte, Black Langshan, and Buff Cochin pullets' eggs all weighed not far from 24 ounces per dozen. As will be seen, the variation in the weight of the eggs was considerable. Rating the lightest eggs (those from Single Comb Brown Leghorn pullets) at 13½ cents per dozen, the prevailing market price in North Carolina when these tests were made, the relative value of eggs from other breeds on the basis of their weight and their real value in proportion to the market price was calculated as follows.

Value of eggs in proportion to their weight.

Breed.	Relative value per dozen.	Value above market price.
	Cents.	*Per cent.*
Single Comb Brown Leghorn pullets	13.5	....
Single Comb Brown Leghorn hens	16.3	20.7
Silver-Laced Wyandotte pullets	16.6	23
Light Brahma pullets	17.54	30
Late-hatched Barred Plymouth Rock hens	17.6	30.4
White Wyandotte hens	17.6	30.4
White Wyandotte pullets	17.7	30.4
White Plymouth Rock pullets	17.7	31.1
Buff Cochin hens	17.8	31.8
Black Langshan pullets	17.8	31.8
Barred Plymouth Rock pullets	18.2	34.8
Barred Plymouth Rock hens	19.7	46
Buff Cochin and Black Langshan pullets	19.9	47.2
Black Minorca pullets	19.9	47.2
Black Langshan hens	20.44	51.4
Light Brahma hens	21.6	60
Pekin ducks (old and young)	26.7	97.8

On the basis of the results obtained the station believes that selling eggs by the pound would be more rational than by the dozen. "On what other article of food will people be content to pay the same price for what may vary over 50 per cent in value? Or what producer of merchantable produce of any other kind will consent to supply all the way up to 55 per cent more than market value and not think to add to the standard price for additional value?" An apparent objection to selling eggs by weight is that they are not generally used in the household in this way. Most recipes call for eggs by number and not by weight. There is no question that weighing the eggs would be more accurate, and recipes are occasionally met with in which this method is followed.—C. F. LANGWORTHY.

RELATION OF FEED TO THE FLAVOR OF EGGS.

Housewives who use many eggs and all who habitually eat them boiled know that there is much difference in the flavor of even those which are undeniably fresh. There is a very general belief that the flavor is influenced by the feed which the hens receive and that materials possessing strong flavors, like onions, turnips, etc., impart an injurious flavor to the eggs. The truth of this belief was shown by recent experiments at the North Carolina Station.

Chopped wild onion tops and bulbs were fed to hens and the length of time before there was a change in the flavor of the eggs was noted, as well as the length of time which must elapse after onion feeding was discontinued before the objectionable flavor would disappear. At the beginning of the trial a half ounce of chopped onion tops per head daily was fed to 12 hens of different breeds. Repeated tests did not show any onion flavor in the eggs until the fifteenth day, when it was distinctly noticeable. The amount of onion fed was doubled for four days and then discontinued. The eggs laid while the larger amount

of onion was fed were so strongly flavored that they could not be used. After discontinuing the feeding of onions the flavor became less noticeable and in a week the eggs were of normal flavor. The main point brought out by the tests was that flavor can be fed into eggs. Therefore it appears that to insure finely flavored eggs it is necessary to restrict runs so that no considerable amount of food which will produce badly flavored eggs can be obtained.

Some years ago the New York Cornell Station, in studying the effect of nitrogenous vs. carbonaceous food for poultry, reported observations on the effect of the different rations on the flavor of eggs. One lot of fowls was fed a mixture of wheat shorts, cotton-seed meal, and skim milk; another lot cracked corn and corn dough. The former ration contained much more nitrogen than the latter. The hens fed corn laid fewer eggs than those fed the nitrogenous ration, but the eggs were larger. The eggs produced by the nitrogenous ration were of a disagreeable flavor and smell, had a small yolk, and did not keep well. The flesh of the poultry fed this ration, however, was darker, more succulent and tender than that of the fowls fed the carbonaceous ration.

These experiments also show that the food has a marked effect on the flavor of eggs. The general experience of poultry raisers is that nitrogenous rations are more profitable to feed since they produce a larger number of eggs. In view of the fact that such a ration, if too rich in nitrogen, may produce eggs of unpleasant flavor, it would seem advisable to note the effect of any ration fed upon flavor and modify it, if the eggs are found to be inferior in this respect.—C. F. LANGWORTHY.

FEEDING MOLDY CORN.

The annual loss of live stock from cerebro-spinal meningitis is quite considerable. Various causes for the spread of this disease have been suggested. One of those popularly believed in is the eating of moldy corn. During the fall and winter of 1898–99 there was a large loss of cattle in Indiana which was attributed to this cause. A wet fall was responsible for large quantities of moldy corn. The popular belief was that the organism causing the fermentation in the corn produced disease in the live stock. The Indiana Station studied the epidemic and its relation to its alleged cause. The disease was found to be cerebro-spinal meningitis. An examination of a large number of specimens of moldy corn from different localities showed that one bacterium and two molds were common to all samples. Other micro-organisms were found, but varied in the different samples.

Tests of the poisonous properties of the moldy corn were made with two horses. After a preliminary feeding period 5 cubic centimeters (about one-sixth ounce) of an active growth in bouillon of the bacterium found in moldy corn was injected under the skin. After an

interval of six hours this was followed by an injection of 10 cubic centimeters. No appreciable effect was observed; not even so much as an abscess occurred. Five days later a similar test was made with a culture of one of the molds isolated from the spoiled corn, and after a like interval a similar test with a culture of the other mold. In neither case was any abnormal symptom observed.

Each of the three micro-organisms was then grown in corn meal previously sterilized. In various ways the horses were induced to eat as much as 5 pounds per head daily of the infected meal, each micro-organism being tested for a period of five days. The effect of the meal inoculated with the bacterium and one of the molds was negative. The meal inoculated with the other mold—a fusarium—produced redness of the gums and some salivation.

The horses were then fed all the spoiled corn they would eat. On the first three days they ate it readily, and after that it was with difficulty that they could be induced to eat any.

On the fifth day one of the horses had slight salivation, occasional colicy pains, and diarrhea. On the seventh day there was some incoordination of movement and stupor. For two days the animal would stand part of the time with the head pressed against the wall, and then quick recovery followed. The second horse showed some irritation of the mucous membranes of the mouth, but never developed any nervous symptoms. The horse was killed, but a post-mortem examination failed to show any lesions. The two horses ate together about 4 bushels of spoiled corn, most of it being consumed during the first week. After the first week the corn had to be mixed with other feed in every conceivable manner in order to induce the horses to eat any of it.

In none of the tests was cerebro-spinal meningitis induced by the moldy grain. The deductions drawn by the station from the investigations follow:

The results of the experiment show that inoculations with cultures of the bacteria and molds were ineffective. Eating of the mashes containing pure cultures showed that only in the case of a growth of a species of fusarium did any intestinal disturbance follow, and that in one case the feeding of the rotted grain produced considerable intestinal disturbance and some nervous symptoms, but that the disturbance was light in the other.

It appears, therefore, that while many of the cases of sickness in stock attributed to eating moldy corn are due to other causes, the continued use of such food may result in intestinal and nervous disorders of a serious nature.—C. F. LANGWORTHY.

PREPARATION OF UNFERMENTED GRAPE JUICE.

A California Station bulletin states that unfermented grape juice has been used for ages, but that generally the use has been restricted to the immediate vicinity of vineyards because the product spoils quickly unless preserved. Modern improvements in methods of preserving has resulted in greatly extending the use of grape juice. However,

the methods of preservation employed have not been uniformly successful, or have frequently resulted in products injurious to health. Heretofore the expense of proper preservation has been so great as to restrict the use of this beverage almost exclusively to medicinal purposes, the price being too high for the regular consumer. The bulletin of the California Station referred to discusses the qualities of pure normal unfermented grape juice, and explains how it may be successfully and economically prepared. Analyses are reported which show that the normal juice or must of grapes contains no alcohol, glycerin, etc., which are the principal constituents of wine, but that its main constituent is grape sugar (generally 20–24 per cent), with some acids (mainly tartaric acid), mineral matter, and nitrogenous compounds (protein). These are all substances of nutritive or therapeutic value, and pure grape juice should contain no others. Unfortunately, analysis has shown that many of the so-called "grape juices" found in the market are not pure, but frequently contain considerable amounts of alcohol, besides injurious preservative materials.

As has been explained in an earlier bulletin of this series,[1] the spoiling of grape juice is due to the action of micro-organisms which, even with the greatest care and cleanliness, get into it and there find conditions specially favorable to their growth and activity. One of the first and main results of the activity of the organisms usually present is the formation of alcohol from the sugar present. The main object of all processes of preservation is therefore to permanently prevent fermentation and at the same time keep the juice clear and attractive in appearance.

To attain the first object there are two general groups of methods, which may be called, respectively, *chemical* and *physical*. All the chemical methods consist in the addition of germ poisons or antiseptics, which either kill the microscopic organisms of fermentation or permanently prevent their growth and increase. Of these substances the principal used are salicylic, sulphurous, boracic acids, saccharin, and, of late, formalin. Many patent preservatives are found on the market, but they nearly all contain one or more of these substances as their active principle. They are all injurious to digestion and in other ways; and it may be said in general that any substance which prevents fermentation will also interfere with digestion, and is therefore to be avoided.

The physical methods work in one of two ways; they remove the germs by some mechanical means, such as a filter or a centrifugal apparatus, or they destroy them by heat, cold, electricity, etc. * * *

The physical methods, especially those which depend upon heating the liquid to a sufficiently high temperature to kill all organisms present, are considered safest and most practical.

The method recommended by the California Station is, in brief, as follows: Only clean and perfectly sound grapes, picked and handled when cool, should be used. After the juice is expressed it is allowed to settle twenty-four hours and then run through a continuous pas-

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[1] U. S. Dept. Agr., Farmers' Bul. 78 (Experiment Station Work—V), p. 29.

teurizer (fig. 4), in which it is heated to 176° F., but comes out not warmer than 77° F. It is again allowed to settle, in closed sterilized casks, and filtered. For this purpose a filter so constructed that the must passes upward through the filtering medium under pressure is recommended. The filtered juice is placed in bottles previously

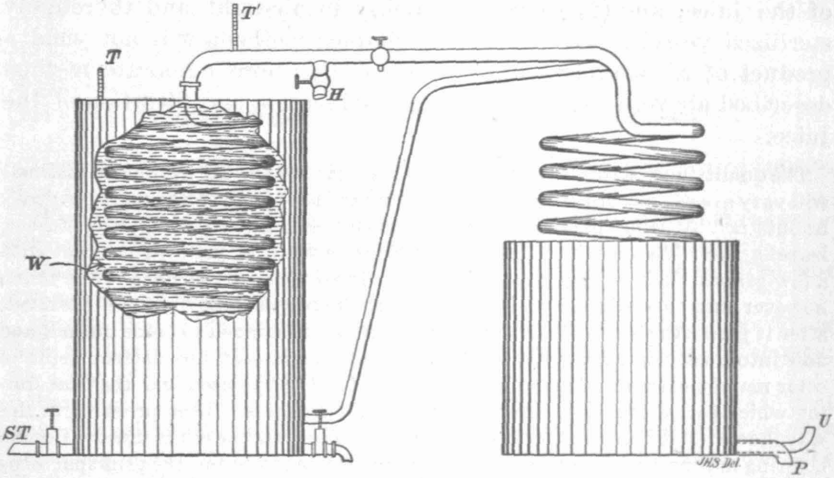

FIG. 4.—A continuous pasteurizer: *ST*, steam pipe; *W*, water bath; *U*, inlet for unpasteurized must; *H*, outlet for hot pasteurized must; *P*, outlet for cooled pasteurized must; *T*, *T'*, thermometers.

sterilized, and the stoppered bottles are placed in a water bath (fig. 5) kept at a temperature of 185° F. for fifteen minutes (for quart champagne bottles). By this means the contents of the bottles are heated to about 167° F. If heated to a higher temperature than was used in the first sterilization the must becomes cloudy. To prevent

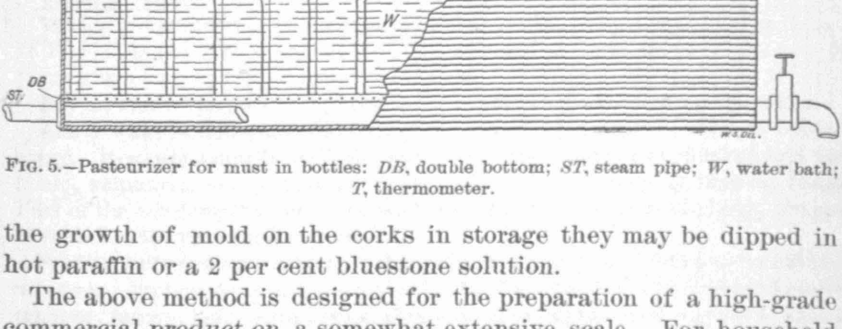

FIG. 5.—Pasteurizer for must in bottles: *DB*, double bottom; *ST*, steam pipe; *W*, water bath; *T*, thermometer.

the growth of mold on the corks in storage they may be dipped in hot paraffin or a 2 per cent bluestone solution.

The above method is designed for the preparation of a high-grade commercial product on a somewhat extensive scale. For household use simpler methods have been found very satisfactory. One of

these simple methods is described in the previous bulletin of this series referred to above. The essential precautions to be observed in carrying out such methods are (1) to heat to a temperature not higher than 175° F. (a lower temperature, 170° F., has been found effective) to secure thorough sterilization without impairing the natural flavor of the juice, and (2) to bottle quickly in air-tight and thoroughly sterilized vessels. Of course the simpler methods will not yield a product of as attractive appearance as the more elaborate method described above, which provides for clarification and filtration of the juice.

The quality and character of the grape juice prepared [by the California method] will vary greatly, according to the variety of grape used, and a pleasing variety may be obtained by using, partially or wholly, grapes of high aroma, such as Muscat, Isabella, etc. The color will, however, always be white or yellowish, except with a few grapes, such as the Bouschets, which have pink or red juice. Red must, however, can be obtained by a modification of the process described. If the must, after it passes through the continuous pasteurizer, is allowed to come out hot and flow into a vat containing the skins of red grapes, almost any desired depth of color may be obtained, depending on the variety of grape used and the time during which the hot must is left in contact with the skins. Must prepared in this way, however, differs in other respects than in color from the white must. Besides coloring matter, various substances are extracted from the skins, the principal being tannin. This makes the composition of the red must more like that of red wine, though of course it still contains no alcohol. A grape juice of this character might appropriately be called "unfermented wine," and would doubtless be useful in medicine, as it would possess certain tonic properties not found in the white must. The regular consumer, however, would in all probability generally prefer the white must.

Grape must, containing as it does generally from 20 to 24 per cent of sugar, is too sweet for many palates and constitutions, but it may be diluted with water by the consumer to any desired extent; and a mixture of equal parts of grape must and carbonated or mineral water makes a beverage much appreciated by many people. In Europe a certain amount of sparkling grape juice is put up—i. e., grape juice which has been carbonated or charged with carbonic-acid gas. This, though an addition to the natural juice of the grape, can not be looked upon in any sense as a fraud or adulteration, and makes the beverage more palatable to many; besides, if properly done, it has no injurious effects on the health of the consumer.

—THE EDITOR.

EXPLANATION OF TERMS.

TERMS USED IN DISCUSSING FERTILIZERS.

Complete fertilizer is one which contains the three essential fertilizing constituents, i. e., nitrogen, phosphoric acid, and potash.

Nitrogen exists in fertilizers in three distinct forms, viz, as organic matter, as ammonia, and as nitrates. It is the most expensive fertilizing ingredient.

Nitrates furnish the most readily available forms of nitrogen. The most common are nitrate of soda and nitrate of potash (saltpeter).

Nitrification is the process by which the highly available nitrates are formed from the less active nitrogen of organic matter, ammonia, salt, etc. It is due to the action of minute microscopic organisms.

Phosphoric acid, one of the essential fertilizing ingredients, is derived from materials called phosphates. It does not exist alone, but in combination, most commonly as phosphate of lime in the form of bones, rock phosphate, and phosphatic slag. Phosphoric acid occurs in fertilizers in three forms—soluble, reverted, and insoluble phosphoric acid.

Superphosphate.—In natural or untreated phosphates the phosphoric acid is insoluble in water and not readily available to plants. Superphosphate is prepared from these by grinding and treating with sulphuric acid, which makes the phosphoric acid more available to plants. Superphosphates are sometimes called acid phosphates.

Potash, as a constituent of fertilizers, exists in a number of forms, but chiefly as chlorid or muriate and as sulphate. All forms are freely soluble in water and are believed to be nearly, if not quite, equally available, but it has been found that the chlorids may injuriously affect the quality of tobacco, potatoes, and certain other crops. The chief sources of potash are the potash salts from Stassfurt, Germany—kainit, sylvinit, muriate of potash, sulphate of potash, and sulphate of potash and magnesia. Wood ashes and cotton-hull ashes are also sources of potash.

TERMS USED IN DISCUSSING FOODS AND FEEDING STUFFS.

Water is contained in all foods and feeding stuffs. The amount varies from 8 to 15 pounds per 100 pounds of such dry material as hay, straw, or grain to 80 pounds in silage and 90 pounds in some roots.

Dry matter is the portion remaining after removing or excluding the water.

Ash is what is left when the combustible part of a feeding stuff is burned away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorin, and carbonic, sulphuric, and phosphoric acids, and is used largely in making bones. Part of the ash constituents of the food is stored up in the animal's body; the rest is voided in the urine and manure.

Protein (nitrogenous matter) is the name of a group of substances containing nitrogen. Protein furnishes the materials for the lean flesh, blood, skin, muscles, tendons, nerves, hair, horns, wool, casein of milk, albumen of eggs, etc., and is one of the most important constituents of feeding stuffs.

Albuminoid nitrogen is nitrogen in the form of albuminoids, which is the name given to one of the most important groups of substances classed together under the general term protein. The albumen of eggs is a type of albuminoids.

Amid nitrogen is nitrogen in the form of amids, one of the groups of substances classed together under the general term protein. Amids, unlike albuminoids, are usually soluble in water, but are generally considered of less value as food than albuminoids.

Carbohydrates.—The nitrogen-free extract and fiber are often classed together under the name of carbohydrates. The carbohydrates form the largest part of all vegetable foods. They are either stored up as fat or burned in the body to produce heat and energy. The most common and important carbohydrates are sugar and starch.

Fiber, sometimes called crude cellulose, is the framework of plants, and is, as a rule, the most indigestible constituent of feeding stuffs. The coarse fodders, such as hay and straw, contain a much larger proportion of fiber than the grains, oil cakes, etc.

Nitrogen-free extract includes starch, sugar, gums, and the like, and forms an important part of all feeding stuffs, but especially of most grains.

Fat, or the materials dissolved from a feeding stuff by ether, is a substance of mixed character, and may include, besides real fats, wax, the green coloring matter of plants, etc. The fat of food is either stored up in the body as fat or burned, to furnish heat and energy.

MISCELLANEOUS TERMS.

Humus is the name applied to the partially decomposed organic (animal and vegetable) matter of the soil. It is the principal source of nitrogen in the soil.

Micro-organism, or microscopic organism, is a plant or animal too small to be seen without the aid of a compound microscope.

Fungus (plural, **Fungi**) is a low form of plant life destitute of green coloring matter; molds and mushrooms are familiar examples. Many diseases of plants are due to fungi.

Bacterium (plural, **Bacteria**) is the name applied in common to a number of different or closely related microscopic organisms, all of which consist of single short cylindrical or elliptical cells or two such cells joined end to end and capable of spontaneous movement. Many kinds of bacteria are harmful and cause diseases and other injurious effects, but many are beneficial. Among the latter are those which give flavor to butter and cheese, and those which enable leguminous plants to use the free nitrogen of the air.

Node.—That part of the stem (usually somewhat enlarged and hardened, especially in grains and grasses) to which the leaves are attached.

Internode.—The part of the stem between the nodes.

Calyx.—The outermost series of leaves (called sepals) of the flower, usually green, but sometimes colored.

Corolla.—The inner circle or set of leaves (called petals) of a flower, usually bright colored.

Drupe.—A fruit consisting essentially of a hard-shelled nut or stone surrounded by a fleshy pulp, as the peach, plum, cherry.

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